# FOREST PEST MANAGEMENT

UNITED STATES
DEPARTMENT OF
AGRICULTURE

FOREST SERVICE

NORTHEASTERN AREA
ST. PAUL FIELD OFFICE

FIELD NOTE 85-1
1985

## RESULTS OF THE NATIONAL MYCORRHIZAE PILOT TEST IN THE NORTHEASTERN AREA

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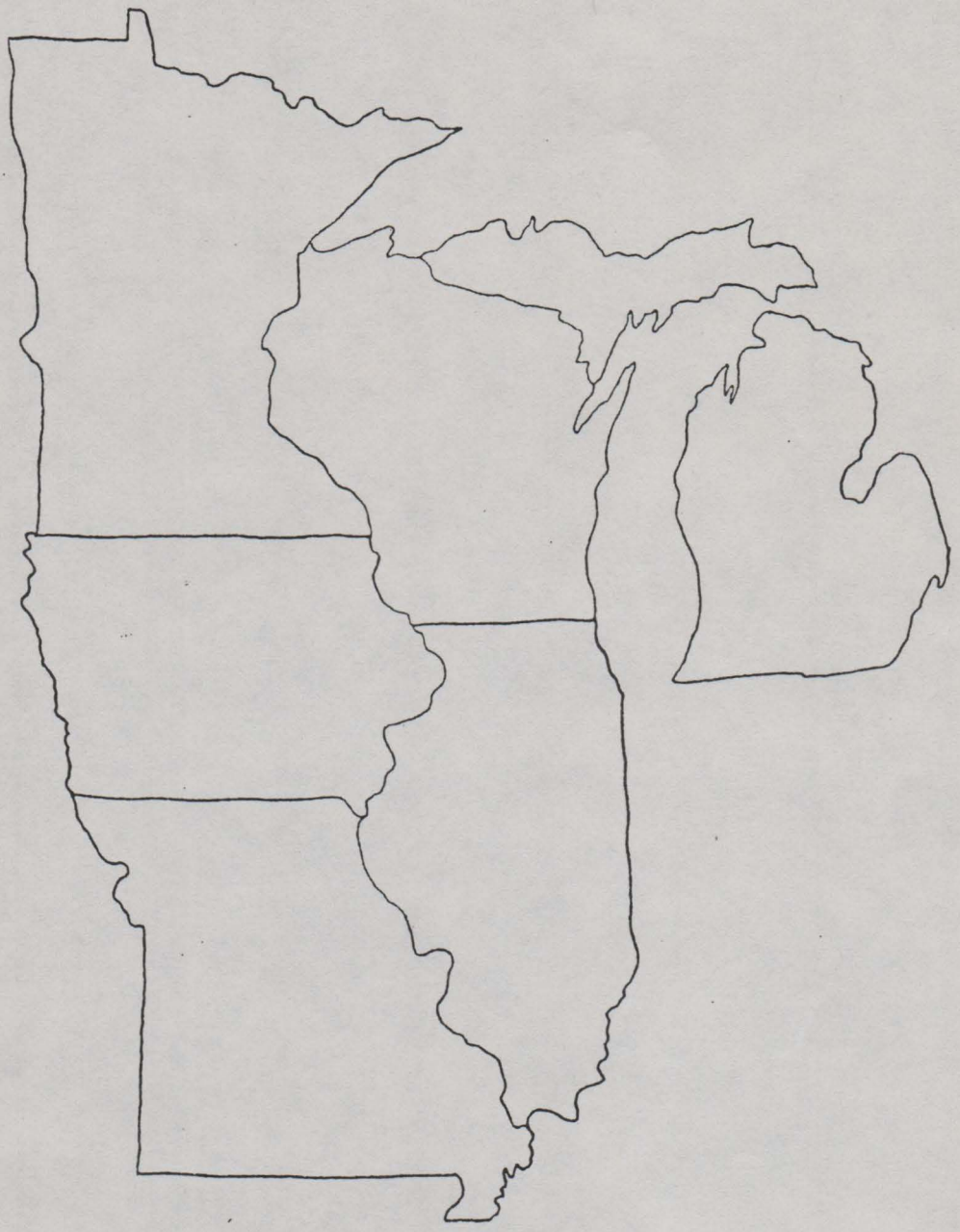

## INTRODUCTION

In the late 1970's the Northeastern Area (NA) became involved in the National Mycorrhizae Pilot Test. The objective of this study was to evaluate the performance of Pisolithus tinctorius (Pers.) Coker and Couch (Pt) inoculated stock, both in the nursery and in outplantings. The nursery phase of the project was completed in 1980 and summarized by Marx et al. (1984). Growth measurements on outplanted stock were taken at planting time and one, two, and four years following planting. Nine NA nurseries were initially involved in the pilot test, however for various reasons, several were not carried through to the field. The current report summarizes results for the remaining seven NA field plantings (Table 1).

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The outplantings were evaluated in two ways, percent survival and plot volume index (PVI = caliper squared (diameter at ground line, $cm^2$) x seedling height (cm) x number surviving seedlings). Each planting site included a control and one or two inoculation treatments, GA 100 or ABB 200. GA 100 inoculum was prepared in the Mycorrhizae Institute Laboratories at Athens, GA and applied at 100 ml inoculum/$ft^2$ of nursery seedbed. ABB 200 refers to inoculum produced by Abbott Laboratories and applied at 200 ml inoculum/$ft^2$ of nursery seedbed. Although all outplanting sites contained GA 100 stock, only three sites were planted with ABB 200 inoculated stock.

Fourth year outplanting growth data are available for all but one site (Jonesboro, IL.). No significant differences ($P = .05$) in seedling survival were noted among the various treatments at any of the seven planting sites (Table 2). At the end of the second growing season, two sites showed significantly greater PVI ($P = .05$) for inoculated stock over uninoculated stock (Table 3). However, by the end of the fourth growing season, no significant difference in PVI ($P = .05$) was found at any of the test locations.

The Cloquet, MN planting showed a significant increase in PVI ($P = .05$) for inoculated over control plots after both the first and second growing seasons. And although not statistically significant, the largest fourth year percent growth difference was observed there (Appendix). However, the validity of these results is questionable; this is a dry, sloped site and although selected at random, four of the five control replicates are at the top of the slope, and four of the five inoculated replicates are at the bottom of the slope. Moisture availability may have influenced tree performance.

Persistence of growth differences into the second growing season at the Missouri planting site is noteworthy. This was the most southerly NA planting site and involved the evaluation of shortleaf pine, a southern pine species. Many mycorrhizal fungi are host specific and have characteristic geographic distributions (Trappe 1962). The Pt isolate used in the pilot test originated in Georgia. Although this fungus forms abundant ectomycorrhizae with a number of southern pine species (Marx and Cordell 1976), the NA pilot test results do not show similar success with northern conifers in the Lake States. It is possible that the particular isolate used in the pilot test was not as well adapted to northern temperatures and/or tree species as it was to southern pine species in the southern U.S. A Lake States isolate of this or another endemic ectomycorrhizal fungus might be better suited for northern U.S. ectomycorrhizal inoculation programs (Croghan 1984, Marx et al. 1984).

Percent increases in growth for inoculated over uninoculated stock is given in the Appendix. Although there were no statistically significant differences between treatments at the planting sites covered in this report, it should be noted that a large increase in growth was observed at a mine land reclaimation site in Indiana (Eby Mine). This suggests the importance of using mycorrhizae tailored stock for successful mine reclaimation efforts.

Since the plantings evaluated in the current summary were established, it has been reported that a Pt index of 50 or more on seedlings is required to obtain favorable responses in tree survival and/or growth in field plantings (Marx et al. 1977, Marx et al. 1984). Seedlings at only two of the NA nurseries (Newaygo, MI and Vallonia, IN) had Pt indices of 50+ when outplanted. These low indices may be in part due to nursery applications of fungicides (Marx et al. 1984).

The results presented here will be incorporated into a report summarizing the national outplanting results for the pilot test.

## ACKNOWLEDGEMENT

The authors wish to extend their thanks to the many land managers, nursery superintendents and pathologists who made this evaluation possible. We also wish to acknowledge the important role Dr. James Allison played in establishing this study. Prior to accepting a pathology position in San Francisco, Dr. Allison coordinated the National Mycorrhizae Pilot Test in the Northeastern Area.

## LITERATURE CITED

Croghan, C. F. 1984. Survey for mycorrhizal fungi in Lake States tree nurseries. Mycologia 76:951-953.

Marx, D. H., C. E. Cordell, D. S. Kenney, J. E. Mexal, J. D. Artman, J. W. Riffle, and R. J. Molina. 1984. Commercial vegetative inoculum of Pisolithus tinctorius and inoculation techniques for development of ectomycorrhizae on bare-root tree seedlings. Forest Science Monograph 25, Supplement to For. Sci. 30.(3), 101 p.

Marx, D. H., W. C. Bryan, and C. E. Cordell. 1976. Growth and ectomycorrhizae development of pine seedlings in nursery beds infested with the fungal symbiont Pisolithus tinctorius. For. Sci. 22:91-100.

Marx, D. H., W. C. Bryan, and C. E. Cordell. 1977. Survival and growth of pine seedlings with Pisolithus ectomycorrhizae after two years on reforestation sites in North Carolina and Florida. Forest Sci. 23:363-373.

Trappe, J. 1962. Fungus associates of ectotrophic mycorrhizae. Bot. Rev. 28:538-606.

Table 1. -- Nursery stock and outplanting information.

| Nursery, Location | Species | Age Class | Planting Site | Year Outplanted |
|---|---|---|---|---|
| Potlach, Cloquet, MN | Pinus resinosa Ait. | 2-0 | Cloquet, MN | 1980 |
| Union State, Jonesboro, IL | P. taeda L. | 1-0 | Elizabethtown, R.D., Shawnee N.F., IL | 1979 |
| George O. White, Licking, MO | P. echinata Mill. | 1-0 | Houston R.D., Mark Twain N.F., MO | 1979 |
| Parsons, Parson, WV | P. strobus L. | 2-0 | Fernow Exp. Forest, Parsons, WV | 1980 |
| NEPCO, Port Edwards, WI | P. resinosa Ait. | 2-0 | Port Edwards, WI | 1980 |
| USDA-SCS, Newaygo, MI | P. resinosa Ait. | 2-0 | Newaygo, MI | 1980 |
| Vallonia Vallonia, IN | P. virginiana Mill. | 1-0 | Harrison-Crawford S.F., IN | 1979 |

Table 2. -- Mean percent survival for outplanted seedlings following first, second, and fourth growing seasons.

| Treatment | Cloquet MN | Jonesboro IL | Licking MO | Parsons VW | Port Edwards WI | Newaygo MI | Vallonia IN |
|---|---|---|---|---|---|---|---|
| 1st Year | | | | | | | |
| Control | 92 a* | 72 a | 91 a | 79 a | 93 a | 96 a | 78 a |
| GA 100 | 98 a | 72 a | 92 a | 81 a | 91 a | 97 a | 81 a |
| ABBOTT 200 | ...** | ... | ... | ... | 83 a | 98 a | 74 a |
| 2nd Year | | | | | | | |
| Control | 89 a | 72 a | 68 a | 50 a | 79 a | 90 a | 68 a |
| GA 100 | 95 a | 76 a | 68 a | 52 a | 91 a | 93 a | 68 a |
| ABBOTT 200 | ... | ... | ... | ... | 82 a | 97 a | 66 a |
| 4th Year | | | | | | | |
| Control | 85 a | ---*** | 66 a | 46 a | 67 a | 90 a | 66 a |
| GA 100 | 91 a | --- | 65 a | 44 a | 80 a | 94 a | 68 a |
| ABBOTT 200 | ... | ... | ... | ... | 66 a | 96 a | 66 a |

* Means in a column followed by different letters are significantly different ($P = .05$) according to Student's T=test (2 means) or Duncans Multiple Range Test (3 means).

** No ABB 200 treatment installed at planting site.

*** Data unavailable.

Table 3. -- Mean plot volume index (PVI) for outplanted stock following first, second, and fourth growing seasons.

| Treatment | Cloquet MN | Jonesboro IL | Licking MO | Parsons VW | Port Edwards WI | Newaygo MI | Vallonia IN |
|---|---|---|---|---|---|---|---|
| 1st Year | | | | | | | |
| Control | 29.7 b* | 149 a | 83 b | 94 a | 84 a | 111 a | --- |
| GA 100 | 47.2 a | 159 a | 653 a | 104 a | 111 a | 81 b | --- |
| ABBOTT 200 | ...** | ... | ... | ... | 97 a | 102 ab | --- |
| 2nd Year | | | | | | | |
| Control | 101.1 b | 740 a | 565 b | 161 a | 263 a | 612 a | --- |
| GA 100 | 173.9 a | 765 a | 1025 a | 185 a | 318 a | 538 a | --- |
| ABBOTT 200 | ... | ... | ... | ... | 264 a | 592 a | --- |
| 4th Year | | | | | | | |
| Control | 1192 a | ---*** | 25607 a | 705 a | 2285 a | 8873 a | 28178 a |
| GA 100 | 1484 a | --- | 31034 a | 683 a | 2801 a | 8351 a | 32986 a |
| ABBOTT 200 | ... | ... | ... | ... | 2273 a | 8902 a | 23669 b |

* Means in a column followed by different letters are significantly different ($P = .05$) according to Student's T-test (2 means) or Duncans Multiple Range test (3 means).

** No ABB 200 treatment installed at planting site.

*** Data unavailable.

Percent increase in survival and growth of Pt inoculated seedlings over uninoculated seedlings.

| Outplanting Site Location | Pine Species | Age | Percent Increase[1] Survival IMRD | Survival Abb. | Ht. IMRD | Ht. Abb. | Diameter IMRD | Diameter Abb. | PVI[2] IMRD | PVI[2] Abb. | Growth IMRD | Growth Abb. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shawnee N.F., IL | loblolly | 4 | 4.2 | - | 5.2 | - | 12.5 | - | 22.4 | - | 22.5 | - |
| Fernow Exp. For., WV | white | 4 | 4.0 | - | 5.6 | - | -1.4 | - | 14.8 | - | 14.8 | - |
| Mark Twain F. F., MO | shortleaf | 4 | -1.5 | - | 7.3 | - | 6.6 | - | 21.2 | - | 21.1 | - |
| Potlatch, MN | red[3] | 2 | 6.7 | - | 24.6 | - | 17.0 | - | 72.0 | - | 77.0 | - |
| Newaygo-SCS, MI | red[3] | 2 | 3.3 | 7.8 | -7.7 | -9.9 | -5.4 | -1.1 | -12.1 | -3.3 | -11.6 | -2.1 |
| Nepco Lake, WS | red[3] | 2 | 15.2 | 3.8 | 5.8 | 1.8 | 0 | -5.6 | 20.6 | 0.3 | 19.1 | -4.6 |
| H-C S.F., IN (1) | Virginia | 4 | 6.1 | 0 | 4.4 | -0.8 | 2.8 | -7.1 | 17.1 | -16.0 | 17.2 | -16.0 |
| H-C S.F., IN (2) | Virginia | 2 | 0 | -5.7 | 1.0 | 8.1 | 5.8 | 13.5 | 26.7 | 37.8 | 39.8 | 54.7 |
| Eby Coal Mine, IN | Virginia | 4 | 7.0 | 8.8 | 14.2 | 15.6 | 25.0 | 23.3 | 82.6 | 63.3 | 77.4 | 61.2 |
| Average | red | - | 8.4 | 5.8[4] | 7.6 | -4.1[4] | 3.9 | -3.4[4] | 26.8 | -1.5[4] | 28.2 | -3.4[4] |
| Average | Virginia | - | 4.4 | 1.0 | 6.5 | 7.6 | 11.2 | 9.9 | 42.1 | 28.4 | 44.8 | 33.3 |

[1] Percent increase of IMRD or Abbott MycoRhiz® Pt-inoculated seedlings over check-uninoculated seedlings.

[2] PVI = Diameter$^2$ x ht. x no. surviving seedlings/treatment plot - ($cm^3$).

[3] All three red pine outplantings were made with 2-0 seedlings vs. standard use of 3.0 red pine seedlings in north central states.

[4] Based on average of PT Abbott MycoRhiz® inoculated 2-0 red pine seedlings outplanted at two locations--Newaygo - SCS, Michigan and Nepco Lake (Nekoosa-Edwards), Wisconsin.